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A MATHEMATICAL MODELING ACTIVITY: MURAT'S MOBILE PHONE

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ABSTRACT

In this study, a mathematical modeling activity was designed and implemented in a seventh grade classroom. The students were first expected to examine a given mathematical model of a problem that is based on a real life situation and then build a model depending on their own criteria. The mathematical modeling activity which was designed by the researchers involves many mathematical concepts and processes such as analyzing data, reading a table, interpreting a table, building a model, drawing a graph, and interpreting a graph. After application of the modeling activity, students were evaluated based on their performance in solving the mathematical modeling questions and almost all were found to be successful. The researchers offered some recommendations through their experiences for teachers. Among these recommendations are that every student should present their mathematical model to class and discuss it with other students.
Keywords: mathematical modeling, building model, data analysis, drawing graph, reading graph.

BİR MATEMATİKSEL MODELLEME ETKİNLİĞİ: MURAT'IN CEP TELEFONU

ÖZ

Bu araştırmanın amacı yedinci sınıf öğrencilerine yönelik hazırlanmış bir matematiksel modelleme etkinliğini uygulama sürecinde öğrencilerin deneyimlerini incelemektir. Bir gerçek yaşam durumunun matematiksel olarak incelendiği problemde, öğrencilerden kendilerine verilen bir matematiksel modeli incelemeleri ve kendi belirledikleri ölçütlerle yeni bir matematiksel model oluşturmaları beklenmiştir. Araştırmacılar tarafından hazırlanan bu matematiksel modelleme etkinliği verileri inceleme, tablo okuma, tabloyu yeniden yorumlama, bir model oluşturma ve grafik çizme-yorumlama gibi birçok matematiksel kavramı ve süreci barındırmaktadır. Uygulanan etkinlik sonucunda öğrencilerin bu matematiksel modelleme sorusunu çözme süreçleri değerlendirilmiş ve hemen hemen tüm sınıf, etkinlik sürecinde başarılı olarak değerlendirilmiştir. Uygulamanın sonunda araştırmacılar, öğretmenlere süreçten elde ettikleri gözlem deneyimlerine dayanarak bazı öneriler sunmuştur. Bunlar arasında tahtada her bir öğrencinin ürettiği matematiksel modelin incelenmesi ve sınıf olarak yorumlar getirilmesi de yer almaktadır.
Anahtar kelimeler: matematiksel modelleme, model oluşturma, veri analizi, grafik çizme, grafik okuma.

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INTRODUCTION

People are exposed almost daily with groups of data represented in various forms, such as tables and graphs, in the written and visual media (Franklin et al., 2005). Data analysis knowledge and skills are necessary for understanding this data. Data analysis knowledge and skills have an important role in making personal decisions, in the progress of science, in the execution of various professional branches, in the development of workplaces, and in the examination of people's opinions sociologically (National Council of Teachers of Mathematics [NCTM], 2000). For example, a customer who wants to buy a particular product can review the tables that compare different brands and models found in the relevant magazines, and make decisions by interpreting the presented data. Based on this significance of the data analysis, education systems in different countries include opportunities for students to collect data throughout the course of their education, to represent collected data, to interpret data, and to develop decision making skills as a result. (Ministry of Education [MoNE], 2018; National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010; New Zealand Ministry of Education, 2014).

The process of data analysis consists of the following steps; *formulating questions*, *collecting data*, *analyzing data*, and *interpreting the results* (MoNE, 2018; Van de Walle, Karp, & Bay-Williams, 2013). In the *formulating questions* step, students create a problem that can be answered with data. For example, they might write a problem that students in the class will research how much time they spend on the internet within 1 day. In the *collecting data* step, how to collect the data is planned and the plan is applied. This stage might involve doing an experiment, collecting data from people, or compiling information about an object. *Analyzing data* is performed in two steps. In the first step, the collected data are organized and classified by tools such as tables or graphs. In the second step, detailed information about the data set is obtained by making calculations such as central tendency measures or dispersion measures on the organized data. In the last step of the data analysis process, *interpreting the results,* the values obtained from data analysis are interpreted and the initial problem is answered. Not every data analysis activity has to contain all four steps. For example, junior high school students can work with readily available data sets collected by others and easily found in the media (NCTM, 2000).

Although data analysis standards are often included in the mathematics curriculum, according to some educators, the data analysis process, in other words, statistics, is a discipline different from mathematics (Burrill & Biehler, 2011; Franklin et al., 2005; Van de Walle et al., 2013). Statistics, unlike mathematics, focus on variability in the data. This variability cannot be interpreted without context. Contextual problems in statistics give meaning to the data while in mathematics they are usually used for application purposes. Therefore, the concept of variability and the role of context constitute the basis for the difference between mathematics and statistics.

Even though mathematics and statistics might be viewed as different disciplines, they do not need to be separated in the education process (Burrill & Biehler, 2011; Franklin et al., 2005). In fact, these two disciplines are interrelated and intertwined. Burrill and Biehler (2011) pointed to mathematical modeling within the topics that can serve as a bridge between mathematics and statistics. The mathematical modeling process, which aims to represent the relationship between two or more variables, often involves analyzing data and interpreting the results steps from the data analysis processes.

Dossey, McCrone, Giordano, and Weir (2002) describe mathematical modeling as expressing the situations in daily life with the aid of mathematics. This concept, which the MoNE (2013) includes as one of the basic mathematical skills, is different from the problem solving process, although it is related to solving everyday life problems. In mathematical modeling activities, students are expected to examine a complex real life situation that is not routinely answered by a single word or a number and to provide mathematical explanations by describing this situation with a mathematical representation such as a formula, a graph, or a table (Lesh & Zawojewski, 2007; Mousoulides & English,

2008). There are many frameworks that describe the mathematical modeling process that has a cyclic structure consisting of many steps, such as understanding and describing the problem, describing variables, analyzing real life situations by doing mathematical analysis, using descriptive explanations, modeling, and confirming the solution. One of these frameworks was prepared by researchers Bliss, Fowler, and Galluzzo (2014). The reason for preferring this framework is that it details the building the model step. It also emphasizes the analysis and evaluation of the produced model and, where appropriate, the modeling process can be repeated as often as desired.

In an activity which is designed based on Bliss et al. (2014) modeling cycle, it is necessary for students to understand the real life problem presented to them first and to describe the variables of this problem. This process is examined in a cyclic form and continues with making assumptions. At the end of this cyclical process, a model is created. Using this model, a result for the problem situation can be found, this result can be analyzed, and lastly the model can be evaluated. If the model does not provide a meaningful solution to the real-life problem, then the modeling process is repeated, particularly the building blocks of the modeling process, understanding the problem and defining the variables are re-examined.

This study aims to engage the participants in experiencing the mathematical modeling process described above by completing a modeling activity and to guide the mathematics teachers who want to implement this activity in future to understand and examine the process. The steps of the mathematical modeling activity which was prepared by the researchers in this context are presented below.

DESIGNING THE MATHEMATICAL MODELING ACTIVITY

The problem situation of the modeling activity was designed by the researchers. While preparing the activity, the researchers benefited from the experiences with elementary school students and the conversations of peer groups in the classroom. In these observations, researchers realized that students told each other about the characteristics of their mobile phones and from time to time they told what characteristics of the mobile phone they would pay attention to if they bought a new mobile phone.

Based on these observations, the "Murat's Mobile Phone" activity was designed and written as a mathematical modeling question. Murat's Mobile Phone activity begins with examining some of the features of five different phones. There are nine features including screen size, battery capacity, memory, and so on (Activity worksheet is given in Appendix 1). These features, given in a table, have their own units of measurement; for example, the CPU frequency, which specifies the speed of the phone processor, is measured in Giga Hertz (GHz). By looking at these features, firstly, students are asked to predict which mobile phone Murat should choose. Then, the mathematical model that Murat created based on his preferences is introduced. Murat's mathematical model is as follows:

$$Total\ Score = \frac{4}{10}.B + \frac{3}{10}.A + \frac{1}{10}.O + \frac{2}{10}.T$$

In this mathematical model, the letter B stands for score for the battery, the letter A stands for score for the rear camera resolution, the letter O stands for score for the front camera resolution, and finally the letter T stands for AnTuTu evaluation score (AnTuTu is a score obtained from a phone's tested properties such as RAM, storage space, etc.). The coefficients in the Murat's mathematical model point out the importance of the properties that are involved in the model. In other words, for example, the largest coefficient in the model is the coefficient of the B symbol, 4/10, indicating that the battery capacity is considered more important for the person who constructed the model than other features. For this reason, each coefficient found in the mathematical model can help to identify which features of a mobile phone is the most important one for the model builder.

This importance-ranking helps to give points from 1 to 5 for the features of the phones. These points are given by students and written in the table in the second question of the activity worksheet (Appendix 1). These points should be given according to decreasing unit of the features of the mobile phone. The result of

entering the points in 1-5 scale in the model produces a total score that allows a comparison of mobile phones based on a numerical data. A mobile phone with a high score is preferred compared to others.

After studying the mathematical model of Murat's mobile phone selection, students are asked to determine their own favorite features while considering buying a mobile phone. The first part of the activity is completed when the students build their own models by specifying the coefficients in the model based on their own preferences. In the second part of the activity, students examine a table that includes mobile phone prices and AnTuTu scores, and represent this data with a graph. The activity is completed with these investigations.

ACTIVITY IMPLEMENTATION

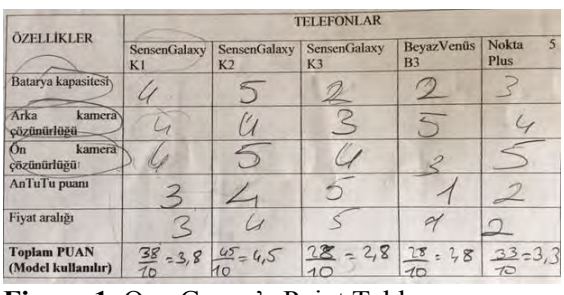
The mathematical modeling activity was applied to seventh grade students enrolled in a state school located in one of South West cities in Turkey. The activity was designed to address three learning objectives. These are "7.2.1.1. Performs addition and subtraction operations with algebraic expressions." "7.4.1.1. Produces a line graph based on the data." and "7.4.1.2. Finds the mean, median, and mode of a data set and interprets it." (MoNE, 2018). The activity was applied during the spring semester of 2017-2018 academic year to a class of 21 students for 2 class hours (80 minutes).

In the motivation phase of the activity, the students were asked "What features would you pay attention to if you would buy a mobile phone?" Students expressed their opinions by giving answers such as screen size, battery capacity, and memory capacity. The motivation part lasted for 5 minutes and then the second phase of the lesson which is the learning/teaching process started. The activity worksheets were distributed (Appendix 1) and students worked on it in pairs.

The problem on the worksheet was read by a student and the teacher asked to class to explain the problem in their own words. One of the students rephrased the problem by his own words and said "A person named Murat has to choose a mobile phone among five phones according to their features and we will help him to choose one."

After that, the mobile phone features such as screen size, battery capacity, camera resolution, memory (RAM), internal storage, CPU frequency, and AnTuTu score which Murat gathered after his research were given in a table and the table was examined with class. After this examination, Murat's mathematical model ($Total\ Score = \frac{4}{10}.B + \frac{3}{10}.A + \frac{1}{10}.O + \frac{2}{10}.T$) was introduced to students.

Some open-ended questions were asked to help students better understand and interpret the mathematical model. One of these questions was "What do you observe about the relationship between the coefficients of each term?" With this question, students realized that the total sum of the coefficients made a complete whole. Another question was "What would be the meaning of the coefficients in this mathematical model?" With this question, the teacher aimed to help students realize that the bigger coefficient represented the most desired feature. Thus, the given mathematical model was examined. Then the students were asked to read the data on the first table on the worksheet and fill out the table in the second question, taking into consideration the features that Murat had preferred. For this purpose, students were required to write point distributions on the table by assigning 5 points to the phone with the highest desired feature and then decreasing the points as the value of the feature decreases. The students who made this point distribution decided which mobile phone Murat would buy by using the mathematical model. One group's point distribution is given Figure 1 below.



ÖZELLİKLER	TELEFONLAR				
	SensenGalaxy K1	SensenGalaxy K2	SensenGalaxy K3	BeyazVenüs B3	Nokta Plus
Batarya kapasitesi	4	5	2	2	3
Arka kamera çözünürlüğü	4	4	3	5	4
Ön kamera çözünürlüğü	4	5	4	3	5
AnTuTu puanı	3	4	5	1	2
Fiyat aralığı	3	4	5	4	2
Toplam PUAN (Model kullanılır)	38/10 = 3,8	45/10 = 4,5	28/10 = 2,8	28/10 = 2,8	33/10 = 3,3

Figure 1. One Group's Point Table

In the table given in Figure 1, students gave 5 points for the phone with the highest battery capacity, 4 points for the next one, and 3 points

for the next. Two phones have got 2 points because there are two phones with the lowest battery capacity. Another point about this table is that the "price range" row was not used in the model. The price range row was included in the table for students to notice unnecessary information.

After analyzing Murat's mathematical model and finding out which phone he should buy, students were asked to determine which features were important to them by asking "Which features will you pay attention to if you want to buy a phone?" Afterwards, they were required to create a mathematical model based on these features. The students were reminded that they do not have to use the 1/10 coefficient for their own model as in Murat's model and that they can use any fraction. The students first determined their preferred features of a phone and then they formed a model. Then they filled the table using the 1-5 point scale and produced a score for five different mobile phones by using the mathematical models that they built. This process corresponds to questions four and five on the activity worksheet. The students decided which phone they would buy by considering the points they had calculated using their model.

In this process, the practitioner researcher (the first author, referred as teacher in the paper) walked between the student desks in order to answer the questions of the students, to lead them when they got stuck, and to ask questions about their models. Some of the teacher's questions were "What is the most important feature for you in your mathematical model? Why? What is the sum of the coefficients in your model?"

The students got results by discussing the answers sometimes among the groups sometimes within the groups. In the figures given below there are two mathematical models built by two groups. In Figure 2, the features of battery, front camera, and screen size are taken into consideration. On the other hand, the sum of the coefficients is more than 1. This has reduced the accuracy of the model. Another group formed the model shown in Figure 3 and determined the coefficients as multiples of 1/100. The sum of the coefficients seems to be designed to give 1 and this indicates that the produced model is correct.

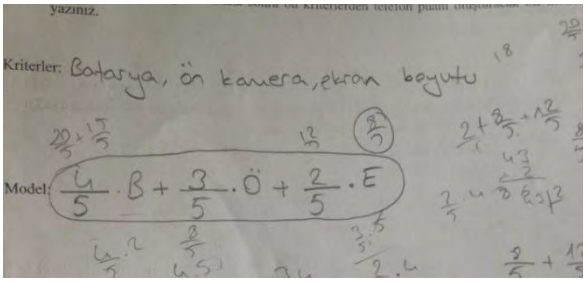


Figure 2. One Group's Mathematical Model

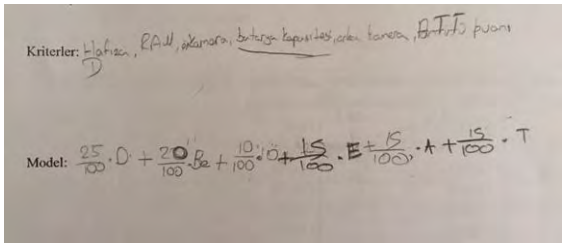


Figure 3. Another Group's Mathematical Model

At the end of the activity, students were given a table involving price of the phones and AnTuTu scores, and a graph paper with the name of x-axis as AnTuTu score, y-axis as price (Appendix 2). Students were asked to draw a graph of a line by using the data given in the table. In this phase of the activity, two critical points were questioned: "Why is the x-axis named as AnTuTu score? And y-axis as price?" and "How would you interpret the line obtained from data?"

It was observed that the students had a bit difficulty to answer the seventh question which is "Why is the x-axis named as AnTuTu score? And y-axis as price?" In order to handle this difficulty, two follow-up questions were asked and discussed: "What is the difference between the data given on the x-axis and y-axis?" and "What if the data given on the x and y axes would exchange and x-axis is named as price and y-axis is named as AnTuTu score, what would change?" In this way, the students were questioned about the concepts of dependent and independent variables without explicitly mentioning the names of these concepts. In this discussion, students remembered what they did during science classes for drawing speed-time graphs, and they were able to transfer knowledge about graphic drawings from one course to another.

In the eighth question (How to interpret the line obtained from data), it was observed that the students identified that when data on the x-axis increased, data on the y-axis also increased. This situation was interpreted as "The prices of the phones increase as the AnTuTu score increases." In fact, the groups have also named this relationship and underlined it as a "linear relationship." The answer of one of the groups about this question is given in Figure 4 below. This group wrote "Because the price increases as the AnTuTu score increases. The AnTuTu score does not increase because the price increases." An example of the graph that one of the groups produced is given below in Figure 5.

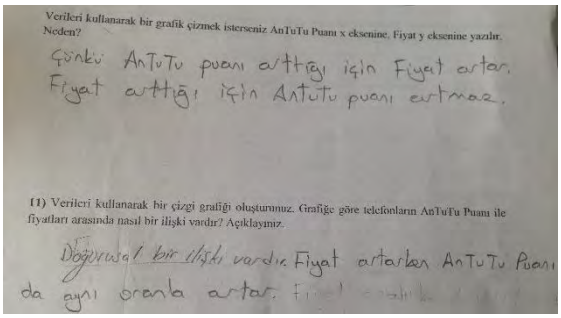


Figure 4. One Group's Interpretation of the Graph

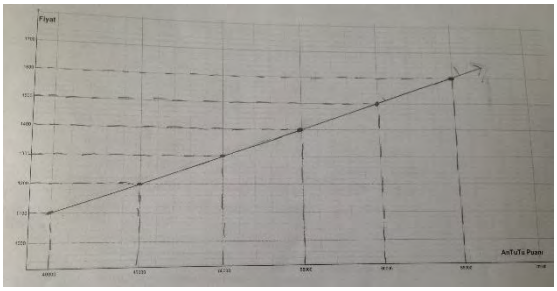


Figure 5. One Group's Graph

At the end of the lesson, it was discussed how useful mathematics could be while solving problems encountered in everyday life. Since the mathematical model produced for mobile phone changes from person to person, so that purchasing process can be different according to the persons, too. The activity was completed by making debates that there may be more than one correct answer in daily life problems.

FINDINGS

Students' activity worksheets were examined by using the rubric (Appendix 3) prepared by the researchers. While preparing the rubric the two dimensions of the activity was considered. The first dimension is constructing a mathematical model and examining it. The second dimension is drawing a graph and interpreting the graph. The dimensions involved 4 and 2 questions respectively, and each question was evaluated through 1 to 3 points according to the rubric. Findings from the worksheets collected from ten groups and evaluated using the rubric are presented in Table 1.

Table 1. Groups' Scores and Related Percentages

	A1	A2	A3	A4	B1	B2	Total score (18 points)	%
G1	3	3	3	3	3	3	18	100
G2	3	3	2	3	3	3	17	94
G3	2	3	3	3	3	3	17	94
G4	2	2	3	3	3	3	16	89
G5	3	3	3	2	3	2	16	89
G6	2	0	0	0	0	0	2	11
G7	3	2	3	2	1	0	11	61
G8	3	2	3	3	3	3	17	94
G9	3	3	2	2	0	0	10	56
G1	3	3	3	3	0	3	15	83

G: Group, A: Steps involving building a mathematical model, B: Steps involving drawing a graph.

According to Table 1, the students were successful in responding to worksheet questions. When these scores are examined only one group (G6) obtained very low score. This group involved special-need students. Since the researcher was not informed in advance about these students, she could not prepare a parallel activity for these students. Because of this situation, these students had to participate in the same activity with the rest of the class. Yet if the researcher had been informed in advance, she could prepare a new activity worksheet which is parallel to Murat's mobile phone and appropriate to their level of learning.

As it can be seen from Table 1, there are no groups beside G6 that has a low evaluation

from the activity processes. Group 7 and 9 have average achievement levels. It is observed that Group 7 obtained low achievement points from the second dimension of the activity which involves drawing and interpreting a graph. This may be because of two reasons, either the students were tired at that time period of the activity and gave up putting effort on drawing or they had lack of conceptual knowledge on drawing and interpreting graphs.

CONCLUSIONS and SUGGESTIONS

In this article, an activity emerging from the interests of the students, the application process of this activity, and the evaluation of the learners were presented. Students generally participated in the activity with interest, constructed a mathematical model, and successfully completed the worksheet. Findings in this study are consistent with previous research on mathematical modeling. It was found that the students who participated in the modeling activities thought that these activities should be used in mathematics lessons and they were helpful to make connections between mathematics and real life (Deniz & Akgün, 2014). Previous research findings indicate that the use of modeling activities has a positive effect on student achievement (Doruk & Umay, 2011).

In addition to evaluating the students' worksheets, the problems encountered while applying the activity and the solutions produced in these situations are as follows: First of all, students had some problems in re-evaluating the phone features by assigning scores over five in the second question. To overcome this problem, students were asked "How can we compare the quantities in different units?" and it was determined that a common unit or a reference point should be determined. As a solution to this problem, during the implementation process, the teachers who will apply this activity might fill in a row of the table in the second question on the worksheet as an example. Thus, students might be able to fill the rest of the table with ease by looking at the sample row.

Another problem experienced in the implementation process is the problems students experienced in "multiplying and adding with fractions" when calculating the scores of mobile phones using the models with fractional expressions. However, the students participated in the activity are expected to learn "M.6.1.5.2. Performs addition and subtraction operations with fractions." and "M.6.1.5.3. Performs and interprets a fraction multiplication with a natural number." learning objectives in the sixth grade. Nevertheless, it has been determined that seventh grade students still make some mistakes while multiplying a fraction with a natural number and adding them all. In order to overcome this problem, it may be suggested that teachers remind the operations performed with fractions to students before applying this activity.

Lastly, the time for the activity can be increased to more than 80 minutes. In this application, the researchers did not have a comprehensive class discussion, even though the activity was completed within 80 minutes. An effective concluding can be done by conducting a discussion on each group's mathematical model that are written on the board and with explanations of groups about how they created their models. Examining each mathematical model written on the board might show to students that the complex situations of everyday life can be overcome with mathematics quite easily and that these solutions may be different from each other. For this reason, classroom discussion is very important. Similarly, for the second part of the activity, teachers who want to apply the activity may have the groups draw their graphs on the board and explain the relation between the variables in front of the whole class.

Mathematical modeling allows students to examine daily life problems under real-life conditions (Bliss et al., 2014). This gives a clear answer to the students' question about how useful mathematics is in real life. For this reason, as emphasized in curriculum, it is recommended to use and study mathematical modeling more frequently in classroom practice.

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Appendix 1

Activity Worksheet

MURAT'S MOBILE PHONE

Murat wants to buy himself a mobile phone. He has done some research, has identified 5 phone models that can be most suitable for himself and his budget, and has listed the features of these phones on a table as below.

Features of Mobile Phones

FEATURES	PHONES				
	SensenGalaxy K1	SensenGalaxy K2	SensenGalaxy K3	BeyazVenüs B3	Nokta 5 Plus
Screen size	5.5 inch	5.5 inch	5.8 inch	5.5 inch	5.5 inch
Battery capacity	3300 mAh	3600 mAh	3000 mAh	3000 mAh	3100 mAh
Back camera resolution	13 MP	13 MP	12 MP	16 MP	13 MP
Front camera resolution	8 MP	13 MP	8 MP	5 MP	13 MP
Memory (RAM)	3 GB	3 GB	4 GB	3 GB	3 GB
Internal storage	16 GB	16 GB	64 GB	16 GB	32 GB
CPU frequency	1.6 GHz	1.6 GHz	2.3 GHz	1.3 GHz	1.5 GHz
AnTuTu score	46.500	47.800	174.000	37.500	45.200
Price range	1500TL	1800 TL	4000 TL	900TL	1200 TL

TL: Turkish Liras
CPU frequency: Maximum speed the phones can work
AnTuTu score: Testing user experience, RAM, storage, etc., and presenting this test to the user as a score

Murat pointed out that he would pay attention to the following phone features:
- The higher the quality of the battery, the longer the charge lasts.
- Camera resolutions should be good.
- The high AnTuTu score indicates that the phone is reliable.

Murat does not give equal importance to every feature. He has created the following model that will generate phone rating points for him:

$$Total\ Point = \frac{4}{10}.B + \frac{3}{10}.A + \frac{1}{10}.O + \frac{2}{10}.T$$

B= Battery capacity score
A= Rear camera resolution score
O= Front camera resolution score
T= AnTuTu evaluation score

1) Examine the features of the five phones. What would be the most suitable phone for Murat? Why?

2) By considering the given scores of phone features in table above, write new points in decreasing order from 5 to 1 in the table below.
(For example, the phone with the highest AnTuTu score is given 5 points, the phone with the next AnTuTu score receives 4 points, etc.).

The New Scores of Phones' Features

Features	PHONES				
	SensenGalaxy K1	SensenGalaxy K2	SensenGalaxy K3	BeyazVenüs B3	Nokta 5 Plus
Battery capacity					
Back camera resolution					
Front camera resolution					
AnTuTu score					
Price range					
Total Points (Use the mathematical model)					

3) Which phone should Murat buy? Why? Does this phone match your initial guess?

4) If you were to buy a mobile phone for yourself, which features would be important for you? Specify these features.
Then write a mathematical model that will generate a total score from these features.

Features:

Mathematical Model:

5) Using the features you specified, write down the appropriate scores in the table below. Then calculate the total score for each phone using your model.

Preferred Features' Scores

FEATURES	PHONES				
	SensenGalaxy K1	SensenGalaxy K2	SensenGalaxy K3	BeyazVenüs B3	Nokta 5 Plus
Screen size					
Battery capacity					
Back camera resolution					
Front camera resolution					
Memory (RAM)					
Internal storage					
CPU frequency					
AnTuTu score					
Price range					
Total Points (use mathematical model)					

6) Which phone do you prefer? Why?

7) Six different brands of mobile phones' prices (rounded to the nearest thousand) and AnTuTu scores are given in the table below.

AnTuTu Score and Price of the Phones

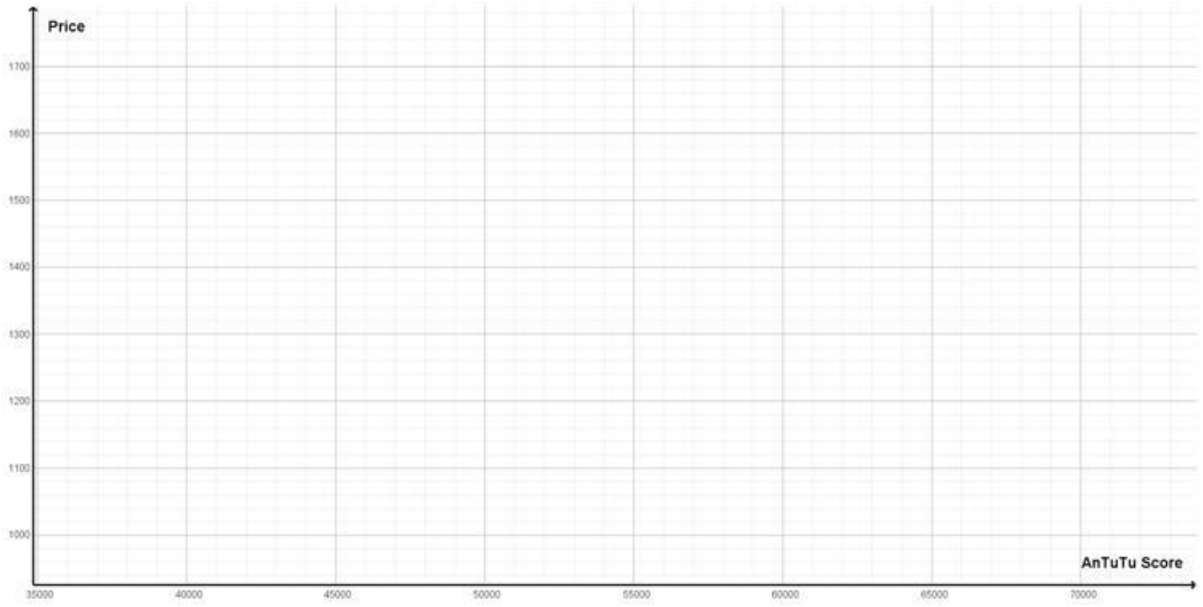
AnTuTuScore	Price
65000	1600 TL
60000	1500 TL
40000	1100 TL
55000	1400 TL
50000	1300 TL
45000	1200 TL

Plot the data given in the table on the graph paper. Why is the price placed on the y-axis and the AnTuTu Score on the x-axis?

8) Draw a line graph using the data. According to the graph, what is the relationship between the price of the phones and their AnTuTu scores**?**

Appendix 2

Graph Paper



Appendix 3

Rubric for Evaluating Steps of Mathematical Modeling of Students

Part A	1 point	2 points	3 points
Reading and interpreting table	An error was made in 3 or more rows, indicating that the student misinterpreted the data.	Although the data and scoring are generally correctly interpreted, there are errors in 1 or 2 rows.	The data were interpreted correctly and the tables were filled in without errors.
Constructing a model	A meaningful mathematical model could not be constructed.	A mathematical model is constructed by considering the features. However, model has some mathematical mistakes. For instance, the sum of the coefficients is not 1.	Features are identified and model is constructed. There is no mathematical error in the model.
Finding a mathematical solution	An incorrect solution was found without using a model or a meaningful method.	The scores of the phones were determined using the model. However, there are computational errors in calculations.	Using the model, the scores of the phones were determined correctly.
Interpreting the solution	The phone model that is required to be bought is written without any justification or by misinterpretation.	It was stated which phone is preferred, but the reason is missing.	According to the mathematical model created, the highest graded phone model is stated as the desired phone.
Part B			
Drawing a graph	Very few points on the graph are identified and no line graph is produced. Or a wrong line graph was produced.	Most or all of the points on the graph are plotted correctly, but a line graph could not be created.	All the points on the graph were determined according to the data and the points were connected to form a line graph.
Interpreting the graph	Focused on a single variable, the relation between two variables is not addressed.	Without giving any detail it is given that the price increases as the AnTuTu score increases.	It is stated that there is a linear relationship between the AnTuTu score and price variables. When the AnTuTu score increases by 5000, then the price of the phone increases by 100TL.